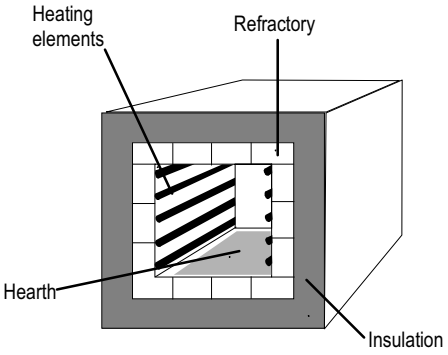
Applied Technology: Indirect Resistance



Source: EPRI TechCommentary V3, N7R, 1994

Concept

Indirect resistance heating involves passing line frequency current through high resistance heating elements. The resistance to the current flow generates heat. The heat is transferred to the workpiece via conduction, convection, and/or radiation. The workpiece temperatures can range from ambient to 1700 C^o (3100 F^o) or more (with an inert atmosphere), depending on the application and type of heating elements. This type of heating is typically performed in a well insulated enclosure, like an electric oven. This minimizes thermal losses and provides a high heating efficiency, typically in the 80% range.

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Applications

- Heat Treating
- Forming
- Melting
- Drying
- Cooking
- Joining
- Curing
- Sintering

Technologies Replaced

- Fuel-Fired Furnace or Flame Hardening
- Salt/Lead Bath Heat Treating

Wastes Reduced

- Combustion Pollutants; ROG, SO_X, NO_X, CO_X, Particulate
- Salt/Lead Bath; hazardous salts/metals

Potential in Manufacturing

Indust	*SIC*	*Pot*	*Indust*	*SIC*	*Pot*	*Indust*	*SIC*	*Pot*	*Indust*	*SIC*	*Pot*	*Indust*	*SIC*	*Pot*
Food	**20**	**HI**	Lumber	24	MED	Chem	28	MED	Stone	32	MED	Elect	36	MED
Tobac	21	MED	Furn	25	MED	Petrol	29	MED	Pmetal	33	MED	Transp	37	MED
Textile	22	MED	Paper	26	MED	Rubber	30	MED	**MetFab**	**34**	**HI**	Instr	38	MED
Apparel	23	MED	Printing	27	MED	Leather	31	MED	Mach	35	MED	Misc	39	MED

Credits: **George Bobart, Bobart Associates; Unimar Group, Ltd; The Electrification Council; Electric Power Research Institute**

Indirect Resistance
continued

Technology Advantages

- Application Flexibility
- Precise Temperature Control
- Melting; can decrease dross or material loss
- Accommodates Special Atmosphere or Vacuum

Technology Disadvantages

- Operating Cost may be high (depends on cost of electricity)

Typical Costs

Capital Costs	O & M Costs	Potential Payback
depends on size and type; usually about same as comparable fossil: $10k - $200k and more	low maintenance; costs highly dependent on electric rates	about 2 years

Installations

Case A - Foundry operations have generally used gas fired pot furnaces to melt aluminum for permanent mold and die casting processes. However, the aluminum reacts with the moisture created by combustion, causing up to 12% dross or metal loss. Gas fired furnaces have very low heating efficiency of 15% - 20% (Indirect Resistance is typically 70%) and melt quality is difficult to control.

Permanent Casting in Hot Springs, Arkansas replaced five of their gas fired melting furnaces with electric indirect resistance melting units. This conversion provided a 28% savings in both energy and maintenance cost, 10% productivity improvement, and reduced metal losses to nearly 0%.

Case B - Kopp Glass of Pittsburgh, Pennsylvania is a jobshop producer of glassware for aircraft, medical, and theatrical applications. Their gas fired oven used for annealing the finished glass was causing problems with startup time, energy cost, temperature control, and downtime for maintenance. Replacing their old unit with a conveyorized indirect resistance electric oven resulted in instant startup/shutdown time and a significant improvement in process control. It also reduced overall energy and maintenance costs.

Major Vendors

Indirect Resistance

Abar-Ipsen Industries
3260 Tillman Drive
Bensalem, PA 19020
(215) 244-4900 (in PA)
(800) 374-7736 (outside PA)

Barnstead/Thermolyne Corp.
2555 Kerper Boulevard
Dubuque, IA 52001
(800) 553-0039

C. I. Hayes, Inc.
800 Wellington Ave
Cranston, RI 02910
(401) 467-5200

Cooperheat, Inc.
1021 Centennial Avenue
Piscataway, NJ 08854
(800) 526-4233

Despatch Industries, Inc.
P.O. Box 1320
Minneapolis, MN 55440-1320
(612) 469-5424

Dynarad Corp.
575 Whitney St.
San Leandro, CA 94577
(510) 638-2000

The Grieve Corporation
500 Hart Road
Round Lake, IL 60073-9989
(708) 546-8225

Industrial Heating and Finishing Co., Inc.
P.O. Box 129
Pelham Industrial Park
Pelham, AL 35124
(205) 663-9595

Lindberg
304 Hart St
Watertown, WI 53094
(414) 261-7000

Seco/Warwick
180 Mercer St
Meadville, PA 16335
(814) 724-1400

Rapid Engineering, Inc.
P.O. Box 700
Comstock Park, MI 49321-0700
(616) 784-0435

Surface Combustion, Inc.
1700 Indian Wood Circle
Maumee, OH 43537
(800) 537-8980

Thermotron
291 Kollen Park Drive
Holland, MI 49423
(616) 393-4580

Thermtronix Corp.
17129 Muskrat Ave.
Adelanto, CA 92301
(619) 246-4500

This list of vendors of the indicated technology is not meant to be a complete or comprehensive listing. Mention of any product, process, service, or vendor in this publication is solely for educational purposes and should not be regarded as an endorsement by the authors or publishers.

Index to EPRI DOCUMENTS

Indirect Resistance

Indirect Resistance Heating, EPRI CMF TechCommentary, Vol 3, No 7R, 1994

Electric Resistance Melting, EPRI CMP TechCommentary, CMP-1188-036, 1988

Resistance Melting for Low Capital Investment, EPRI CMP TechApplication, CMP-045, 1989

Electric Ladle Preheaters, EPRI CMP TechCommentary, CMP-0589-024, 1988

All-Electric Annealing Furnace, EPRI CMP TechApplication, CMP-075, 1991

Electric Resistance Ladle Preheating Improves Foundry Operations, EPRI CMP TechApplication, CMP-079, 1992

Resistance Melting - A Bellringer at Temple Aluminum, EPRI CMP TechApplication, CMP-086, 1993

Electric Resistance, Indirect Radiant-Heated Sand Reclaimer Economic Answer to Sand Reclamation, EPRI CMP TechApplication, CMP-087, 1993

This information is designed to help you determine **potential** applications for the technology. You are encouraged to contact one of the listed vendors or a consultant for details and pricing.

This manual is not intended as a recommendation of any particular technology, process, or method. Mention of trade names, vendors, or commercial products do not constitute endorsement or recommendation for use. It is offered for educational and informational purposes and is advisory only.

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